CLAIMS

1. A method of finding the time offset between signals transmitted by at least one of a plurality of transmitters (A,B,C) of a communications network and received by a receiver attached to a terminal, the method comprising the steps of

(a) creating at the terminal a terminal section ($r(t)$) of a representation of the signals from the transmitters received by the receiver;

(b) creating a first section ($S_A(t)$) of a representation of the signal transmitted by a first (A) of said transmitters, and creating a second section ($S_B(t)$) of a representation of the signal transmitted by a second (B) of said transmitters, each of which sections overlaps in time with the terminal section ($r(t)$);

(c) creating a first function ($\hat{a}(\tau)$) dependent on the first section ($S_A(t)$) and the terminal section ($r(t)$), and convolving the first section with the first function to form a blurred estimate ($b(t)$) of the signal received at the terminal from the first transmitter (A);

(d) creating a second function ($p_A(\tau)$) dependent on the first section ($S_A(t)$), and convolving the terminal section with the second function to form a blurred terminal section ($r(t) * p_A(\tau)$);

(e) subtracting the blurred estimate ($b(t)$) from the blurred terminal section ($r(t) * p_A(\tau)$) to produce a blurred residual representation ($r'(t) = r(t) * p_A(\tau) - b(t)$); and

(f) estimating the time offset between the blurred residual representation ($r'(t)$) and the second section ($S_B(t)$).

2. A method according to claim 1, wherein the first function ($\hat{a}(\tau)$), which is used to create the blurred estimate, is a windowed cross-correlation of the first section ($S_A(t)$) with the terminal section ($r(t)$), created by enhancing the significant components of the cross-correlation function.

3. (Cancelled)

4. A method according to claim 1, wherein the second function ($p_A(\tau)$), which is used to create the blurred terminal section, is the auto-correlation profile ($p_A(\tau)$) of the first section ($S_A(t)$).

5. A method according to claim 1, wherein the blurred residual representation ($r'(t) = r(t) * p_A(\tau) - b(t)$) is cross-correlated with the second section ($S_B(t)$) of a representation of the signal transmitted by a second (B) of said transmitters to estimate the time offset.

6. A method according to claim 1, wherein the first ($S_A(t)$) and second ($S_B(t)$) sections are created at the respective first (A) and second (B) transmitters.

7. A method according to claim 1, wherein the first ($S_A(t)$) and second ($S_B(t)$) sections are created in one or more sampling devices attached to the respective transmitters or located elsewhere.

8. A method according to claim 1, wherein the first ($S_A(t)$) and second ($S_B(t)$) sections are created by computer programs running anywhere in the communications network, or elsewhere, using information supplied from the network about the transmitted signals.

9. A method of finding the time offset relative to a reference within the terminal of a component of a signal transmitted by one of a plurality of transmitters of a communications network and received by a receiver attached to a terminal, the method comprising the steps of

(a) creating a terminal section of a representation of the signals from the transmitters received by the receiver;

(b) creating as a transmitter section a section of a representation of the signal transmitted by an other transmitter, which transmitter section overlaps in time with the terminal section created;

(c) creating a first function dependent on the terminal section and the transmitter section created in steps (a) and (b), and convolving the terminal section with the first function to form a blurred estimate of the signal received at the terminal from the other transmitter;

(d) creating a second function dependent on the terminal section, and convolving the terminal section with the second function to form a blurred terminal section;

(e) subtracting the blurred estimate from the blurred terminal section to produce a blurred residual representation; and

(f) estimating the time offset between the blurred residual representation and the signal component.

10. A method according to claim 9, wherein the first function, which is used to create the blurred estimate, is a windowed cross-correlation of the transmitter section with the terminal section created by enhancing the significant components of the cross-correlation function.

11. (Cancelled)

12. A method according to claim 9, wherein the second function, which is used to create the blurred terminal section, is the auto-correlation profile of the transmitter section.

13. A method according to claim 9, wherein the known components of the transmitted signals are pilot codes.

14. A method according to claim 9, wherein, before the time offset is estimated, the known signal components of the transmitted signals are blurred by convolution with another function.

15. A method according to claim 9, wherein the section of the representation of the signals transmitted by a transmitter is created at that transmitter.

16. A method according to claim 9, wherein the section of the representation of the signals transmitted by a transmitter is created in one or more sampling devices attached to the respective transmitters or located elsewhere.

17. A method according to claim 9, wherein the section of the representation of the signals transmitted by a transmitter is created by a computer program running anywhere in the communications network, or elsewhere, using information supplied from the network about the transmitted signals.

18. A method according to claim 9, wherein the section of the representation of the signals received by the receiver at the terminal is recorded in the terminal before being sent to a computing device.

19. A method according to claim 9, wherein the section of the representation of the signals received by the receiver at the terminal is transferred in real time to the computing device and a recording made there.

20. A method according to claim 9, wherein the representation of the signals received by the receiver attached to the terminal is a digitised version of the received signals converted first to baseband in the receiver.

21. A method according to claim 9, wherein the representation of the signals transmitted by a transmitter (A,B) is a digitised version of the transmitted signals converted first to baseband.

22. (cancelled)23. Apparatus for finding the time offset between signals transmitted by at least one of a plurality of transmitters (A, B, C) of a communications network and received by a receiver attached to a terminal, the apparatus comprising

(a) processing means arranged to create at the terminal a terminal section ($r(t)$) of a representation of the signals from the transmitters received by the receiver;

(b) processing means arranged to create a first section ($S_A(t)$) of a representation of the signal transmitted by a first (A) of said transmitters, and to create a second section ($S_B(t)$) of a representation of the signal transmitted by a second (B) of said transmitters, each of which sections overlaps in time with the terminal section ($r(t)$);

(c) processing means arranged to create a first function ($\hat{a}(\tau)$) dependent on the first section ($S_A(t)$) and the terminal section ($r(t)$), and to convolve the first section with the first function to form a blurred estimate ($b(t)$) of the signal received at the terminal from the first transmitter (A);

(d) processing means arranged to create a second function ($p_A(\tau)$) dependent on the first section ($S_A(t)$), and to convolve the terminal section ($r(t)$) with the second function ($p_A(\tau)$) to form a blurred terminal section ($r(t)*p_A(\tau)$);

(e) processing means arranged to subtract the blurred estimate from the blurred terminal section to produce a blurred residual representation ($r(t)*p_A(\tau)-b(t)$); and

(f) processing means arranged to estimate the time offset between the blurred residual representation ($r(t)*p_A(\tau)-b(t)$) and the second section ($S_B(t)$).

24. Apparatus for finding the time offset relative to a reference within the terminal of a component of a signal transmitted by one of a plurality of transmitters of a

communications network and received by a receiver attached to a terminal, the apparatus comprising

(a) processing means arranged to create at the terminal a terminal section of a representation of the signals from the transmitters received by the receiver;

(b) processing means arranged to create, as a transmitter section, a section of a representation of the signal transmitted by an other transmitter;

(c) processing means arranged to create a first function dependent on the terminal section, and convolve the terminal section with the first function to form a blurred estimate of the signal received at the terminal from the other transmitter;

(d) processing means arranged to create a second function dependent on the terminal section and the transmitter section created in steps (a) and (b), and convolve the terminal section with the second function to form a blurred terminal section;

(e) processing means arranged to subtract the blurred estimate from the blurred terminal section to produce a blurred residual representation; and

(f) processing means arranged to estimate the time offset between the blurred residual representation and the signal component.

25. A telecommunications terminal having an apparatus for finding the time offset between signals transmitted by at least one of a plurality of transmitters of a communications network and received by a receiver attached to a terminal, the apparatus comprising

(a) processing means arranged to create at the terminal a terminal section of a representation of the signals from the transmitters received by the receiver;

(b) processing means arranged to create a first function dependent on a first section of a representation of the signal transmitted by a first of said transmitters which overlaps in time with the terminal section and which is sent to the terminal and on the terminal section created at the terminal in step (a), and convolve the first section with the first function to form a blurred estimate of the signal received at the terminal from the first transmitter ;

(c) processing means arranged to create a second function dependent on the first section, and convolve the section created at the terminal with the second function to form a blurred terminal section;

(d) processing means arranged to subtract the blurred estimate from the blurred terminal section to produce a blurred residual representation; and

(e) processing means arranged to estimate the time offset between the blurred residual representation and a second section of a representation of the signal

transmitted by a second of said transmitters which overlaps in time with the section created at the terminal and which is sent to the terminal.

26. A telecommunications terminal having an apparatus for finding the time offset relative to a reference within the terminal of a component of a signal transmitted by one of a plurality of transmitters of a communications network and received by a receiver attached to a terminal, the apparatus comprising

(a) processing means arranged to create at the terminal a terminal section of a representation of the signals from the transmitters received by the receiver);

(b) processing means arranged to create a first function dependent on the terminal section and a transmitter section being a section of a representation of the signal transmitted by another transmitter which is sent to the terminal, and convolve the terminal section with the first function to form a blurred estimate of the signal received at the terminal from the other transmitter;

(c) processing means arranged to create a second function dependent on the transmitter section, and convolve the terminal section with the second function to form a blurred terminal section;

(d) processing means arranged to subtract the blurred estimate from the blurred terminal section to produce a blurred residual representation; and

(e) processing means arranged to estimate the time offset between the blurred residual representation and the signal component.

27. A communications network for finding the time offset between signals transmitted by at least one of a plurality of transmitters of a communications network and received by a receiver attached to a terminal, the network comprising

(a) a computing device or devices;

(b) a terminal having a radio receiver attached to the terminal, means for creating a terminal section of a representation of the signals, received by the radio receiver, from the transmitters of the communications network, and means for sending the terminal section to the computing device or devices;

(c) sampling devices associated with respective first and second of said transmitters for creating respective first and second sections of representations of the signal transmitted by the respective transmitters which overlap in time with the terminal section, and for sending the sections of the representations created at said transmitters to said computing device or devices;

the computing device or devices being adapted to perform

1 creation of a first function dependent on the first section and the terminal section, and a convolution of the first section with the first function to provide a blurred estimate of the signal received at the terminal from the first transmitter;

2 creation of a second function dependent on the first section, and a convolution of the terminal section with the second function to provide a blurred terminal section;

3 a subtraction of said blurred estimate from the blurred terminal section to produce a blurred residual representation;

4 a calculation of the time offset between the blurred residual representation and said second section.

28. A communications network for finding the time offset relative to a reference within the terminal of a component of a signal transmitted by one of a plurality of transmitters of a communications network and received by a receiver attached to a terminal, the network comprising

(a) a computing device or devices;

(b) a terminal having a radio receiver attached to the terminal, means for creating a terminal section of a representation of the signals received by the radio receiver from the transmitters of the communications network, and means for sending the section to the computing device or devices;

(c) a sampling device associated with an other transmitter for creating, as a transmitter section, a section of a representation of the signal transmitted by the other transmitter which overlaps in time with the terminal section, and for sending the section of the representations created at the other transmitter to said computing device or devices;

the computing device or devices being adapted to perform

1 creation of a first function dependent on the transmitter section and the terminal section, and a convolution of the transmitter section with the first function to provide a blurred estimate of the signal received at the terminal from the other transmitter;

2 creation of a second function dependent on the transmitter section, and a convolution of the terminal section with the second function to provide a blurred terminal section;

3 a subtraction of said blurred estimate from the blurred terminal section to produce a blurred residual representation;

4 a calculation of the time offset between the blurred residual representation and the signal component.

29. A computing device or devices for use in a communications network comprising a terminal having a radio receiver attached to the terminal, means for creating a terminal section of a representation of the signals received by the radio receiver from the transmitters of the communications network, and means for sending the terminal section to the computing device or devices; and sampling devices associated with respective first and second of said transmitters for creating respective first and second sections of representations of the signal transmitted by the respective transmitter which overlap in time with the section created at the terminal, and for sending the sections of the representations created at said transmitters to said computing device or devices,

the computing device or devices being adapted to perform

1 creation of a first function dependent on the first section and the terminal section, and a convolution of the first section with the first function to provide a blurred estimate of the signal received at the terminal from the first transmitter;

2 creation of a second function dependent on the first section, and a convolution of the terminal section with the second function to provide a blurred terminal section;

3 a subtraction of said blurred estimate from the blurred terminal section to produce a blurred residual representation;

4 a calculation of the time offset between the blurred residual representation and said second section.

30. A computing device or devices for use in a communications network comprising a terminal having a radio receiver attached to the terminal, means for creating a terminal section of a representation of the signals, received by the radio receiver, from the transmitters of the communications network, and means for sending the terminal section to the computing device or devices; and a sampling device associated with an other transmitter for creating, as a transmitter section, a section of a representation of the signal transmitted by the other transmitter which overlaps in time with the section created at the terminal, and for sending the section of the representations created at the other transmitter to said computing device or devices,

the computing device or devices being adapted to perform

1 creation of a first function dependent on the transmitter section and the terminal section, and a convolution of the transmitter section with the first

function to provide a blurred estimate of the signal received at the terminal from the other transmitter;

2 creation of a second function dependent on the transmitter section, and a convolution of the terminal section with the second function to provide a blurred terminal section;

3 a subtraction of said blurred estimate from the blurred terminal section to produce a blurred residual representation;

4 a calculation of the time offset between the blurred residual representation and the signal component.

31. A computer program or programs comprising computer program code means stored on a computer-readable medium and for use in a communications network comprising a terminal having a radio receiver attached to the terminal, means for creating a terminal section of a representation of the signals, received by the radio receiver, from the transmitters of the communications network, and means for sending the terminal section to the computing device or devices; and sampling devices associated with respective first and second of said transmitters for creating respective first and second sections of representations of the signal transmitted by the respective transmitter which overlap in time with the section created at the terminal, and for sending the sections of the representations created at said transmitters to said computing device or devices, the computing device or devices being adapted to perform

1 creation of a first function dependent on the first section and the terminal section, and a convolution of the first section with the first function to provide a blurred estimate of the signal received at the terminal from the first transmitter;

2 creation of a second function dependent on the first section, and a convolution of the section created at the terminal with the second function to provide a blurred terminal section;

3 a subtraction of said blurred estimate from the blurred terminal section to produce a blurred residual representation;

4 a calculation of the time offset between the blurred residual representation and said second section.

32. A computer program or programs comprising computer program code means stored on a computer-readable medium and for use in a communications network comprising a terminal having a radio receiver attached to the terminal, means for

creating a terminal section of a representation of the signals, received by the radio receiver, from the transmitters of the communications network, and means for sending the terminal section to the computing device or devices; and a sampling device associated with another transmitter for creating, as a transmitter section, a section of a representation of the signal transmitted by the other transmitter which overlaps in time with the terminal section , and for sending the section of the representations created at the other transmitter to said computing device or devices, the computing device or devices being adapted to perform

1 creation of a first function dependent on the transmitter section and the terminal section, and a convolution of the transmitter section with the first function to provide a blurred estimate of the signal received at the terminal from the other transmitter;

2 creation of a second function dependent on the transmitter section, and a convolution of the terminal section with the second function to provide a blurred terminal section;

3 a subtraction of said blurred estimate from the blurred terminal section to produce a blurred residual representation;

4 a calculation of the time offset between the blurred residual representation and the signal component.

33. A method according to claim 1, further comprising the step of calculating the position of a mobile terminal in a communications network.